CGIAR

RESEARCH PROGRAM ON
Roots, Tubers and Bananas

Planning for greater impact:
RTB current thinking

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CIP

Bioversity International

CIAT
Centro Internacional de Agricultura Tropical
International Center for Tropical Agriculture
A member of the Consultative Group on International Agricultural Research

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AGRICULTURAL RESEARCH FOR DEVELOPMENT

IITA
Research to Nourish Africa

A broad alliance of research-for-development stakeholders & partners

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ABBREVIATIONS

A4NH	CGIAR Research Program on Agriculture for Nutrition and Health
BBTD	Banana bunchy top disease
Bioversity	Bioversity International
BXW	Banana Xanthomonas wilt
CAADP	Comprehensive Africa Agriculture Development Program
CCAFS	CGIAR Research Program on Climate Change, Agriculture and Food Security
CCARDESA	Centre for Coordination of Agricultural Research and Development for Southern Africa
CGIAR	Organization dedicated to international agricultural research
CIAT	International Center for Tropical Agriculture
CIP	International Potato Center
CIRAD	Centre de Coopération Internationale en Recherche Agronomique pour le Développement
CORAF	West and Central African Council for Agricultural Research and Development
GCP 21	Global Cassava Partnership for the 21st Century
Humidtropics	CGIAR Research Program on Integrated Systems for the Humid Tropics
IDO	Intermediate development outcome
IICA	Inter-American Institute for Cooperation on Agriculture
IITA	International Institute for Tropical Agriculture
IRD	Institut de Recherche pour le Développement
LAC	Latin America and the Caribbean
M&E	Monitoring and evaluation
NGO	Nongovernmental organization
OFSP	Orange-fleshed sweetpotato
PIM	CGIAR Research Program on Policies, Institutions and Markets
PIPA	Participatory Impact Pathway Analysis
RBM	Results Based Management
R&D	Research & development
RTB	CGIAR Research Program on Roots, Tubers and Bananas for Food Security and Income
SLO	System-level outcome
SMART	Specific, measurable, attainable, relevant, and time-bound
SSA	Sub-Saharan Africa
UNDG	United Nations Development Group
VAD	Vitamin A deficiency
W 1/2/3	Window 1/2/3 — CGIAR Funding system

1. SYNTHESIS

Across the developing world smallholder farmers and their families struggle with hunger, food insecurity, poverty, and threats to their livelihoods from a changing climate. But thanks to the continued support by donors, the CGIAR's Research Programs (CRPs) offer a comprehensive approach to delivering targeted agricultural solutions for substantive, sustainable impacts. The CGIAR Research program on Roots, Tubers and Bananas for Food Security and Income (RTB) is a broad alliance led by the International Potato Center (CIP) jointly with Bioversity International, the International Center for Tropical Agriculture (CIAT), the International Institute for Tropical Agriculture (IITA), and CIRAD (Centre de Coopération Internationale en Recherche Agronomique pour le Développement). A growing number of research and development (R&D) partners extend and strengthen the alliance. RTB brings together research on its mandate crops — bananas (and plantains), cassava, potato, sweetpotato, yams, and minor roots and tubers — through a product portfolio of seven themes with respective theme leaders.

An important emphasis of RTB in 2014 will be the piloting of **Results Based Management** (RBM) to optimize research-for-development outcomes and enhance value for money through evidence-based impacts. Importantly, the RBM framework is flexible and iterative, incorporating experiential insights and lessons to improve its utility. RBM is guided by the achievement of quantified indicators of progress in research and of Intermediate Development Outcomes (IDOs). The RBM framework links strategic objectives to a set of *flagship products* that draw multidisciplinary expertise from the different RTB themes. The flagship product is the centerpiece of a work package that also consists of linked, or enabling, products and is embedded in a *flagship* that includes a theory of change with quantified indicators.

RTB features three types of flagships:

- **Delivery flagships** focus on near market-ready research products that will generate significant outcomes and impact over the next nine years. They include outcome support services to create the capacities, development partnerships, and innovation environment for product delivery to take outcomes to scale and enhance gender equity. These flagships entail articulation with value chains and client-responsive seed systems to create demand pull, and include participatory research to continuously improve the flagship and linked products. Delivery flagships address a wide range of RTB concerns and inquiry, including: pre-emptive, emergency, and ongoing response capacity to epidemic RTB diseases that affect smallholder producers; improved technology for cassava processing that favors rural women; accelerated multiplication of potato seed for productivity gains; and promoting orange-fleshed sweetpotato varieties to address vitamin A deficiency in vulnerable groups, especially children under three years.
- **Discovery flagships** provide well-targeted, high-potential upstream research, contributing to next- and end-user outcomes in the longer term. Examples include next-generation breeding to accelerate genetic gain in yield and quality traits in a client-responsive way, and game-changing traits for recalcitrant challenges to breeding. Discovery flagships will generate products for delivery once proof of concept is established.
- **Learning & support flagships** enhance research and outreach in other flagships and initiatives and learn from them in a feedback loop. They capture significant synergies across RTB crops in fields such as vegetative propagation in seed systems with bulky and potentially pathogen-laden seed and postharvest value addition to address issues of bulkiness, perishability and consumer preferences.

RTB will link with systems CRPs such as Humidtropics through shared action sites with joint research, and with the CRP on Policies, Institutions and Markets (PIM) through complementary approaches to value chain analysis and development. It will link to thematic CRPs such as Agriculture for Nutrition and Health

(A4NH), where there are shared outcomes around biofortified varieties and to commodity CRPs such as Maize and Grain Legumes for intercropping as well as Livestock and Fish, where RTB crops can be sources of feed.

RTB will continue to support top-class research organized at the theme level and will increase its partnerships with advanced research institutes to this end. Outcome support will require enlarged expertise, including customer outreach, capacity strengthening, and advocacy. This will underpin greater involvement of development partners, including government agencies, nongovernmental organizations (NGOs), and the private sector.

RTB's gender strategy is an integral part of the approach to client responsiveness at the research level and to achieving outcomes, including improved gender equity where possible.

2. RESULTS BASED MANAGEMENT

In 2012 RTB initiated a structured process for shifting from an output-focused research agenda to RBM. The RBM framework will improve program performance, enhance achievement of outcomes, and increase value for money through evidence-based impacts. According to the United Nations Development Group (UNDG) (2009), RBM requires that "*all actors involved ensure that their processes, products and services contribute to the achievement of shared development results (outputs, outcomes and goals)*."

RBM rests on a theory of change linking research outputs, outcomes, and goals with clearly defined accountability at these different levels. The RBM cycle (Fig. 1) begins with setting a vision for RTB, then implementing regular monitoring and evaluation (M&E) of progress toward the goals (strategic objectives) and using results from M&E to manage the program.

RBM focuses on improved performance that can be described and measured while helping individuals to plan, manage, and learn more effectively. This process of shifting to RBM is still underway. The framework and business case for RTB will be fully developed and implementation piloted in 2014 & 2015. The remainder of this section is organized by the first three stages of the RBM cycle.

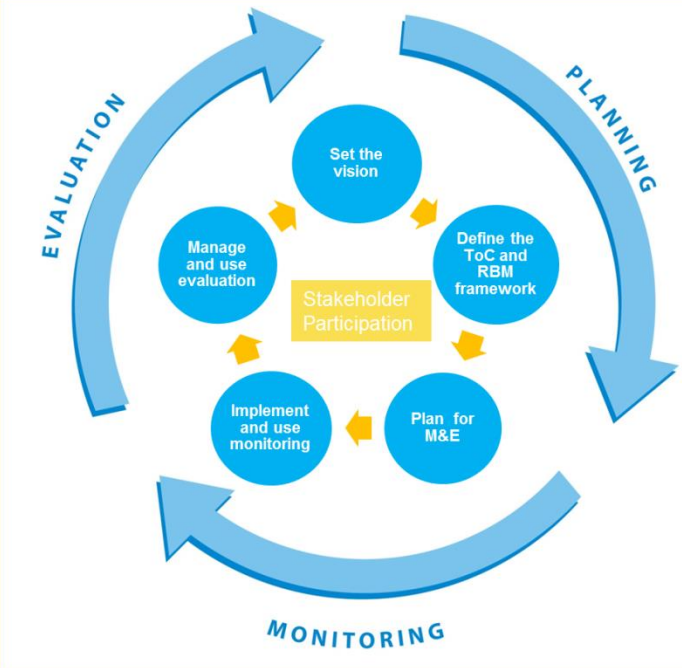


Figure 1. Results Based Management Cycle From: UNDG 2009

2.1 Set the vision

The RTB vision rests on the four system-level outcomes (SLOs) defined for CGIAR as a whole. The detailed RTB proposal (2011) explained how RTB crops contribute to this vision by more fully realizing "*the potential of RTB for improving nutrition, income generation, and food security—especially among some of the world's poorest and most vulnerable populations. The program is building on the expertise, complementarities, and comparative advantages of four CGIAR Centers—Bioversity International, CIAT,*

CIP, and IITA—along with their partners and stakeholders. It will build on the common characteristics of RTB and strong cross-center collaboration to increase efficiencies and capacity. The greater scale and synergies of this new partnership offer a unique opportunity to enhance scientific advancements, share knowledge, and spur uptake to increase RTB research for development impacts."

2.2 Define the theory of change and RBM framework

Initially, RTB organized research around seven themes (Fig. 2). These themes were used to build a product portfolio by crop, including a set of synergistic products that crosscut crops (see http://www.rtb.cgiar.org/product-portfolio/).

Theme leaders were designated with specific responsibilities for the crosscutting work. They guided the development of a set of synergistic projects in 2012 that created a stronger team structure amongst CGIAR partners and increasingly other R&D partners. Accountability in this structure, however, is limited to the generation of products (research outputs) and their yearly milestones with reporting but no clear accountability for "outcomes".

The program portfolio also brought together in a clearly structured way research with shared mandates of CGIAR Centers for bananas and cassava, providing a strong basis for inter-center collaborative work initiated in 2012.

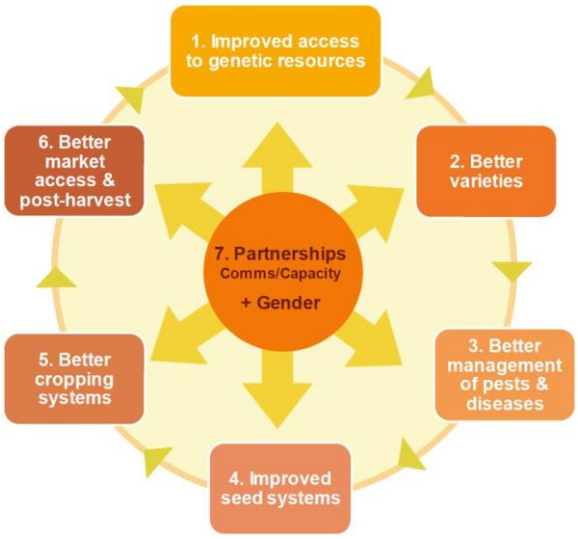


Figure 2. RTB Research Themes

A generic theory of change, known as the "impact pathway," was constructed for RTB as a whole (Fig. 3). This impact pathway links research products to seven IDOs[1] agreed for RTB:

1. **Productivity**: Improved productivity in pro-poor RTB food systems (SLO 2).
2. **Food Security**: Increased and stable access to food commodities by rural & urban poor (SLO 2,3).
3. **Nutrition**: Improved diet quality of nutritionally vulnerable populations, especially women and children (SLO 3).
4. **Income**: Increased and more gender-equitable income for poor participants in RTB value chains (SLO 1, 2).
5. **Policies**: More effective policies supporting development and use of pro-poor and gender inclusive RTB technologies developed and adopted by agricultural organizations, national governments and international bodies (SLO 1, 2).
6. **Environment**: Minimized adverse environmental effects of increased RTB production, processing and intensification (SLO 4).
7. **Future Options**: Improved ecosystem services for enhanced food system stability & sustaining novel genetic diversity for future use (SLO 2, 4).

[1] RTB IDOs are aligned with the concept and wording of the Common CRP IDOs (see IDO Design Group, 10 October 2013: Result of CRP Discussion of the Common IDOs. P. 1f).

The theory of change shows the causal linkage to the SLOs via the impact pathway and the need for outcome support or facilitation for the outcomes to carry through. The impact pathway shows how research products of different types need to come together to achieve research and development outcomes—for example, as approaches to shorten generations for seed multiplication can contribute to accelerated adoption of new varieties. Of course, achieving outcomes is an inherently uncertain process: it requires changes in knowledge and practices by many players in an innovation system. Outcome support creates an enabling environment, which increases the likelihood that the desired changes will occur. Under the proposed RBM framework, RTB assumes responsibility for outcome facilitation to ensure that the right partners and stakeholders are engaged, capacities are developed, and a policy environment is conducive to adopting technologies and achieving outcomes. The RBM framework also requires that an array of stakeholders buy into and contribute to the participatory development of impact pathways and assume a shared responsibility. This is considered in section 3.

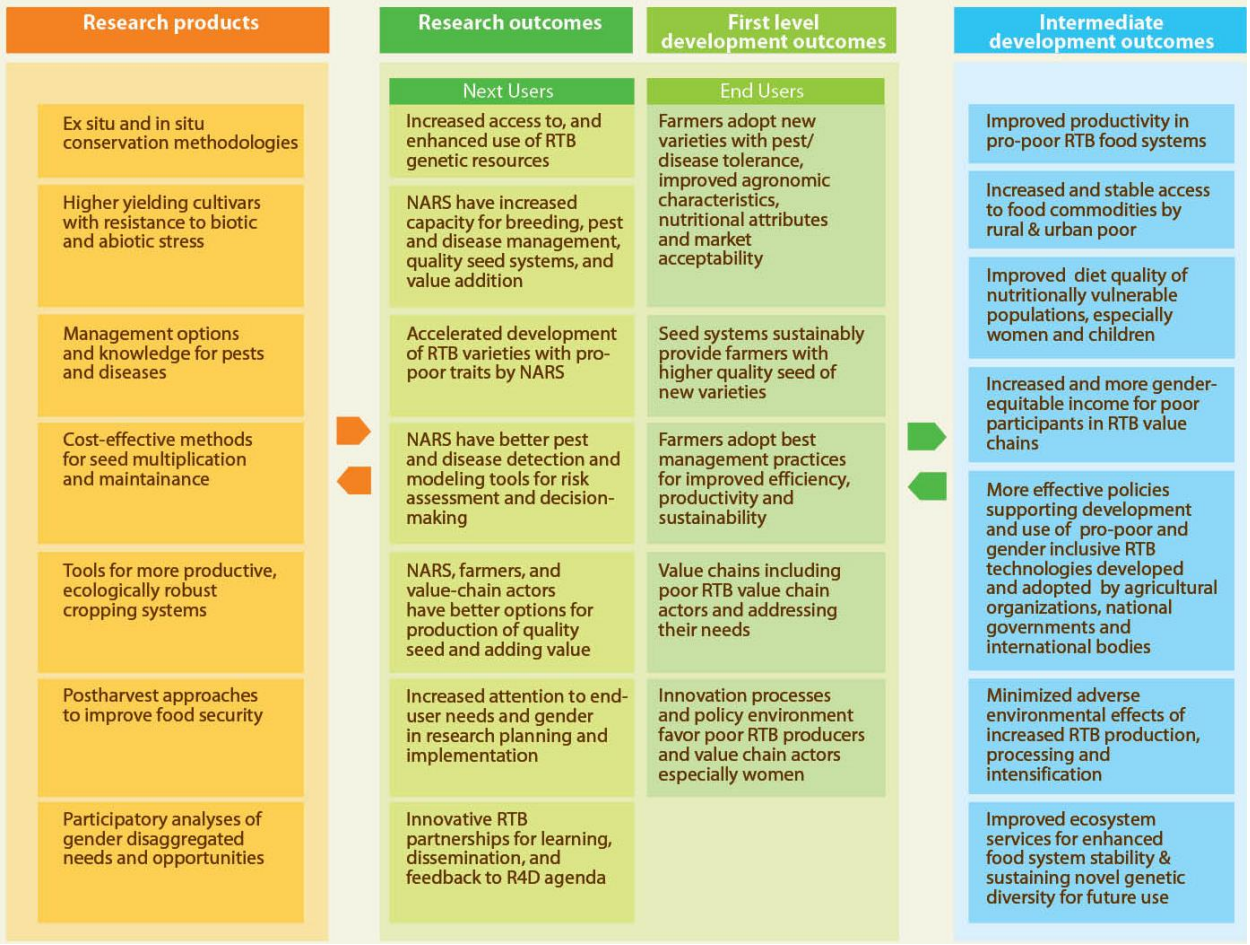


Figure 3. RTB Impact Pathway and Intermediate Development Outcomes

To provide the framework for RBM, in 2012 RTB began to develop from this generic theory of change more disaggregated impact pathways linked to a set of strategic objectives. The strategic objectives are based upon the opportunity for RTB research to make a difference in terms of SLOs and improve the welfare of beneficiaries. Each strategic objective is linked to a flagship product.

A flagship product:

1. Is a significant measurable and time-bound deliverable, based on an **output of research** that results from a **research activity** or set of related activities attributable to RTB.
2. Is used by a well-defined group of **next users** who may be either researchers or development actors, with strong evidence of **demand pull** from these users.
3. Is a near **market-ready** set of ideas, technologies, or science products that generate **excitement amongst researchers and other users**.
4. Has potential for **large-scale impact**.

The assembly of **flagship products**, linked products, impact pathway, and strategic objectives is referred to for simplicity as a "**flagship**." It requires a work package comprising both the research needed to develop and improve the products and the outcome support including capacity strengthening that is also required to achieve the strategic objective. Gender aspects are taken into consideration in an integrative manner to improve user orientation and adoptability of technologies and to improve gender equity.

As just one example, Figure 4 shows a flagship product (centerpiece), "Small- and medium-scale processing centers targeted preferentially toward rural women," with a set of linked, or enabling, products including appropriate varieties and protocols for product quality.

Figure 4. Illustrative flagship product: small and medium scale cassava processing centers targeted preferentially toward rural women

RTB teams, including partners, are preparing a set of flagship descriptions with impact pathways and quantified indicators. Flagship descriptions are available in draft form at (https://drive.google.com/folderview?id=0BySTISZPO4d1Tm1aaFJXQ0xHVkE&usp=sharing)

Three types of flagships have been developed:

- **Delivery flagships** emphasize outcome support to create the capacities, development partnerships, and innovation environment for product delivery to take outcomes to scale. These flagships require articulation with value chains and client-responsive seed systems to create demand pull. They include client-oriented research to continuously improve the flagship and linked products.
- **Discovery flagships** focus on well-targeted, high-potential upstream research contributing to outcomes in the longer run. Some of the outputs of these flagships will generate products for delivery, once proof of concept is established.
- **Learning & support flagships** enhance outreach from other flagships and initiatives and learn from them in a continuous feedback loop leading to expanded outcomes.

Table 1 presents a selection of RTB flagship products illustrative of the approach. They are derived from the full set presented in Annex 1.

Table 1. Representative RTB flagship products by type, strategic objectives and target area by 2023

Type	Flagship Product	Strategic Objective (summary)	Target Area
Delivery	Recovery, containment, and quarantine strategies for smallholder banana production with *Banana Bunchy Top Disease (BBTD)*	R&D banana stakeholders in sub-Saharan Africa (SSA) and Asia are mobilized to build programs which ensure smallholder banana production under the threat of BBTD	Africa, South and Southeast Asia; as risk avoidance in Latina America and the Caribbean (LAC)
	Small to medium scale cassava processing centers targeted preferentially toward rural women	Higher income and better health and safety for participants, especially women	SSA, Asia, LAC (Andean zone, North-East Brazil)
	"3G" (three generations) approach to accelerate seed multiplication and delivery	In five years, at least 350,000 smallholder households will have increased their potato yields by 50%, with an additional income of at least $US 2,000	SSA
	Candidate resilient, nutritious, orange-fleshed sweetpotato (OFSP) varieties	By 2020, at least 15 million resource-poor households with children under 5 years old in vitamin A-deficient regions improve their diet quality by 20 percent and increase their crop income by 15 percent	SSA, Asia, the Caribbean
	Affordable and pest- and disease-free yam planting material	Increase knowledge and promote technologies to sustainably address challenges facing seed yam systems	West Africa
Discovery	Improved RTB Varieties realizing accelerated genetic gains	Accelerate genetic gain in populations and advanced breeding lines whilst ensuring user orientation in RTB crops by 1–3%.	SSA (West and East), Asia, LAC
	Global Network of RTB in-situ conservation monitoring sites	Support and enable effective local to global in-situ management of RTB landraces and their crop wild relatives	Asia/Oceania, LAC, SSA
Learning & support	Framework for analyzing and intervening in RTB seed systems	Build innovation systems to pilot and scale out mechanisms to improve access to smallholder communities to quality RTB planting material and new varieties	Global

Note: The inclusion of certain flagship products here is merely didactic. No type of priority for resource use or implementation is implied. This is still a work in progress, as teams continue to refine information about number of beneficiaries.

Delivery flagships closely correspond to the concept of scalable technology and the linked inventory proposed by the U.S. Agency for International Development (see http://agrilinks.org/blog/scalable-agricultural-technologies-inventory). They require active outcome support and facilitation with knowledge management, capacity strengthening, and close attention to gender equity. They pass through four stages as the scale of RTB outcomes increases (Table 2). Stage 1 focuses on client-oriented participatory research to assemble the flagship and linked products for piloting. Stage 2 may still have significant client-oriented research to adapt flagship and linked products as new demands become apparent in the scaling process. In stages 3 and 4 the emphasis shifts to outcome support. There will be a significant component of research on delivery systems with considerable scope for improving gender equity. The progressive scaling up and shifting from one stage to the next will be based upon proof of efficacy and efficiency for scaling, shown through baseline and counterfactual information and rigorous impact evaluation.

Table 2. Stages of delivery flagships

	Stage 1: Assembly	Stage 2: Pilot	Stage 3: Scaling out	Stage 4: Scaling up
Scale of impact	Client oriented research	<10,000 farmers	<100,000 farmers	1–10 million farmers
RTB role	Lead	Lead	Coordinate	Convene
Research emphasis	***	***	**	*
Outcome support emphasis	*	**	***	***

Note: * = significant, ** = important, *** = major emphasis

Prototype impact pathways leading to IDOs have been developed for the delivery flagships and are included in the flagship descriptions. The impact pathway in the OFSP example (Fig. 5) shows how the flagship and linked products lead to research outcomes with next users, which in turn trigger development outcomes with end users or beneficiaries. These outcomes are all essential for the logic of the impact pathway to carry through. OFSP varieties have to be available as vines, and women, as primary caregivers, need improved knowledge of OFSP's contribution to reducing vitamin A deficiency (VAD) if OFSP is to be adopted significantly. In turn, greater adoption of OFSP would help reduce occurrences of VAD among the critical under-three population.

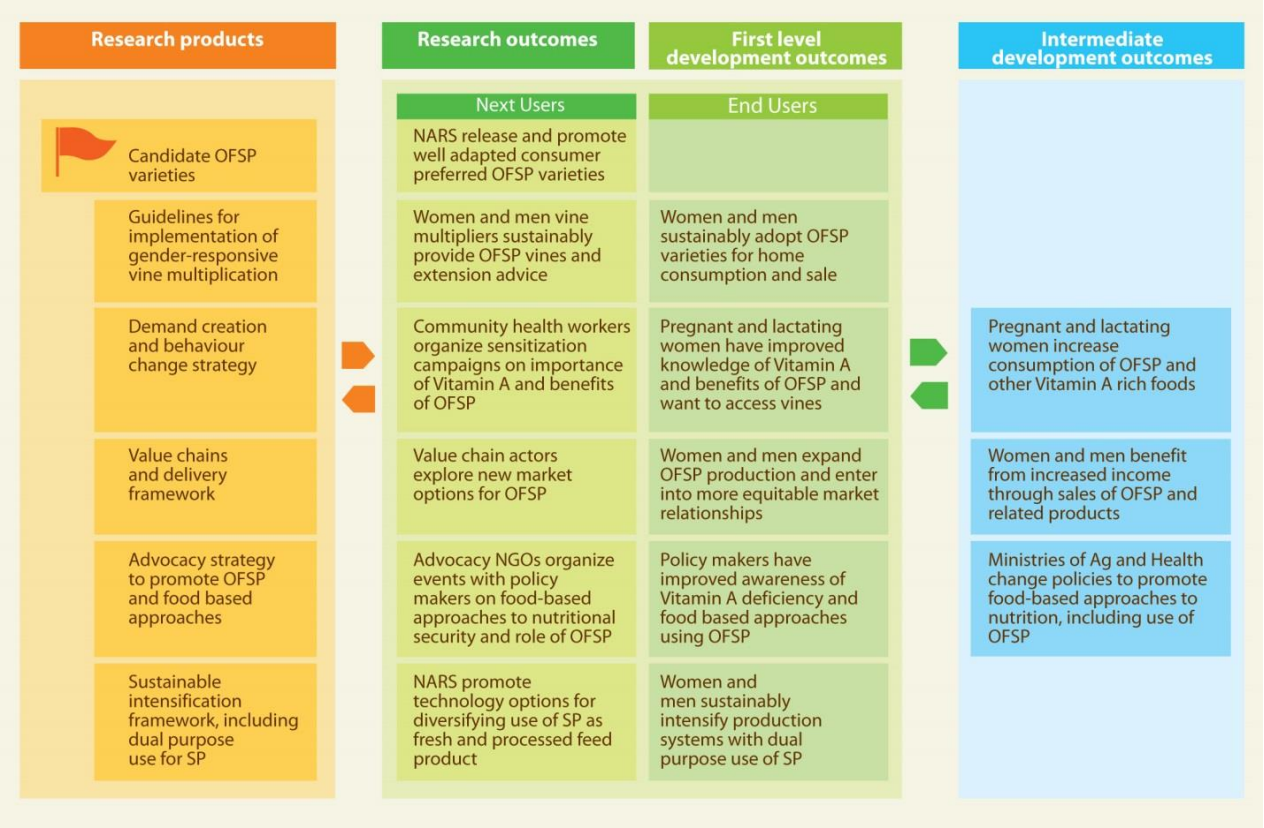


Figure 5. Prototype impact pathway for OFSP flagship

Strategic research partners have been involved in developing impact pathways. During RBM piloting in 2014 and 2015, meetings at regional and national levels are planned to get stakeholder feedback and buy in. This will build on an array of existing and new partnership platforms and mechanisms. Proven

methods such as outcome mapping and participatory impact pathway analysis (PIPA) will be used (see http://www.outcomemapping.ca/ and http://en.wikipedia.org/wiki/Participatory_impact_pathways_analysis).

In the case of discovery and learning & support flagships, the theory of change carries through via the delivery flagships and other initiatives. Hence indicators of research progress and outcomes with next users will provide the basis for RBM rather than IDOs.

2.3 Plan for monitoring and evaluation

M&E will rely on a continuous process of collecting and analyzing information and an ongoing assessment of the planned, ongoing, and completed interventions to address:

- **Strategy/Planning**. Are we doing the right things: rationale/justification; confirm or challenge the theory of change.
- **Operation/Management**. Are we doing things right: effectiveness in achieving expected outcomes, efficiency in optimizing resources, client satisfaction; problem alert; analysis of why intended results were or were not achieved; exploration of unintended results.
- **Learning**. Are there better ways of doing it: alternatives, best practices, lessons learned; recommendations for improvement.
- **Accountability and Reporting**. Reporting to donors and other stakeholders.

By constructing the flagship descriptions and working through the impact pathway, a set of quantified indicators have been developed by flagship for the most relevant IDOs. Table 3 shows a synthesis of the most relevant indicators by IDO for selected flagships. Indicators are formulated on "SMART" (specific, measureable, attainable, relevant, and time-bound) criteria to ensure that core ideas of outcomes are precisely reflected and captured and allow for a structured measurement of program progress. The information in the table will be improved with the on-going RTB priority assessment which runs different impact models and has generated preliminary estimates of potential adoption area, identification of target countries and probable number of poor beneficiaries (see Annex 4 for ex-ante estimates of adoption).

Table 3. Indicators showing contribution of selected delivery flagships to RTB IDOs by 2023

Flagship / RTB-IDO	Productivity	Food security	Nutrition	Income	Environment	Policies
Recovery, containment and quarantine strategies for smallholder banana production with BBTD	● 106,000 households (HH) produce 20t/year commercial Cavendish from 1 ha recovered from BBTD ● 120,000 HH produce 5t/year from 5 ha	650,000 HH in SSA and 300,000 HH in Asia HH avoid banana yield losses of 100% due to BBTD	120,000 HH recover more nutrient rich diets from banana	HH recovering banana production from BBTD, 50% achieve a 20% increase in women's income and 80% income increase	--	--
Small to medium scale cassava processing centers targeted preferentially	--	--	• Production of high quality food products allow 5,000,000 consumers in Africa;	• 15% reduction in production costs for 1,275,000 farmers in SSA, 1,300,000	Discharge of processing waste into surface water eliminated.	--

Flagship / RTB-IDO	Productivity	Food security	Nutrition	Income	Environment	Policies
toward rural women			1,000,000 in Asia; and 500,000 in the Americas to reduce the risks associated with unsanitary and poorly processed cassava	farmers in Asia, and 465,000 farmers in LAC • 50,000 small and medium processing plants increase profitability 15-20% by adding value to waste		
3G approach to accelerated seed multiplication and delivery	350, 000 smallholder beneficiaries increasing yields by 70%	--	--	Network of 2,500 decentralized seed multipliers established, achieving a profit of $1500/ha /year	--	--
Candidate resilient, nutritious orange-fleshed sweetpotato varieties	-	-	15 million resource poor HH increase diet diversity score by 20%, 50% under 5s consume OFSP twice a week	15 million resource poor HH increase their crop income by 15% with 50% involving benefits to women	-	-
Affordable and Pest and Disease-free Yam Planting Material	40% productivity increase in ware yam systems in West Africa	Pre- and post-harvest loss due to pests and diseases reduced by 50% in the target areas	--	26,000 yam growers cultivate quality seed yams, female planting material growers increase by 10%/year and double income	--	Improved yam varieties cover at least 50,000 ha through the ECOWAS variety release and planting material certification schemes

Note: The 7th IDO (Improved ecosystem services/novel genetic diversity for future use) is left out, as it relates primarily to the in-situ conservation flagship, which is not included here.

Agricultural research requires careful, long-term planning. RTB will continue to use the existing product portfolio structure based on the program's original seven themes, although the research products will become more aggregated and focused as they are restructured and prioritized by flagship. As the theme-portfolio and flagships are linked to the same IDOs and respective indicators, M&E will be based on a combined system of research milestones, flagship research/development outcomes, and IDO indicators. The basis for M&E with discovery flagships is illustrated in Table 4 for the next-generation breeding discovery flagship, where a set of breeding targets have been established that include both yield and gains in quality and other traits.

Table 4. Examples of targets for genetic gains in next-generation breeding flagship

	Target environment	Target Trait	Current level of trait	Target level 2023
Banana & Plantain	East Africa	Yield, earliness; Drought tolerance & Fusarium resistance; Nematode & weevil resist	7.6 t/ha; 0% For multilocational testing	60% increase & earliness; In multilocational trial; Varieties released
	West and Central Africa	Yield, earliness; Tolerance to drought	6.1 t/ha	200% yield increase; Drought-tolerant & early-maturing varieties in trial
	Latin America	Yield; Resistance to Sigatoka Fusarium disease	9.8 t/ha; Sigatoka 0%	100% yield increase; Sigatoka-plantain varieties & Fusarium-resistant Silk varieties
	Asia	Yield; Sigatoka resistance	24.5 t/h; Sigatoka 0%	50% yield increase; Sigatoka-resistant plantain varieties
Cassava	Asia	Yield, starch content	Medium-high (25%)	High (32%)
	Latin America	High pro-vitamin A (> 25ug B-carotene) elite cultivars	Low provitamin A content (< 4ug B-carotene)	High provitamin A content (> 20ug B-carotene)
	West and Central Africa	Yield & CMD preemptive CBSD resistance; High pro-vitamin A (>15 ug/g fresh weight B-carotenes); High dry matter poundable, low CNP	30 t/ha with dry matter > 35%; 1/3 target level of beta-carotenoids; Dry matter content less than 30%	2% annual dry yield gains in breeding populations; Target > 2% increase in carotenoids content and dry matter content per year
	East Africa	Yield, Dry Matter; CMD & CBSD resistance; Culinary attributes	Limited availability of CBSD tolerance in varieties	2% annual dry yield gains with combined resistance to CMD and CBSD
Potato	Tropical Highlands and mid-elevation tropics	Late blight resistance (LB), earliness, drought tolerance, biofortification, Fe, Zn & Vit C	LB Resistance score = 6 in predominant varieties, earliness ≥ 120 days	Resistance score = 2 in 30% of potato area, earliness 90-100 days
	Subtropical Lowlands	Earliness; Virus resistance; Heat tolerance; Cold chipping, dry matter	Maturity period > 90 days; Susceptible to viruses; Heat tolerance: 10% clones; tuberize at 18°C night temperature	70-day in 30% clones; Combined resistance PVY, PVX, PLRV; 20% adapted clones tuberizing at up to 25°C
	Temperate and mid altitude	Yield, earliness,& virus resistance, &salinity tolerance	8 t/ha in 100 days,virus susceptible, salinity tolerance 5% clones	9.6 t/ha in 90 days; Extreme resistance viruse; Salinity tolerance 20%
Sweetpotato	Tropical and sub-tropical lowlands and mid-elevation tropics	Yield and earliness	8 t/ha 120 days	9.6 t/ha 100 days
		SPVD resistance	< 1% in breeding populations	10% in breeding populations
		Adaptation to drought-prone environments	Drought-resistant clones; 0–10% respond to rains	Drought-resistant clones; 20–30% respond to rains
		Non-sweet and storability	10% dry weight basis sucrose <30 days	6% dry weight basis sucrose 60 days
Yams	West Africa	High yield and dry matter anthracnose resistance nematode resistance	Below 10 t/ha; Postharvest losses 30-40%.	Above 30 t/ha. Resistance to anthracnose & viruses; Reduce postharvest losses by 30%

The stages of delivery flagships mentioned above can be positioned in a nine-year timeframe (Table 5). Each stage has a differing emphasis. The transition from one stage to another marks a break; invites for midterm evaluations and assessments; and offers an opportunity to learn, to reassess, and to revise strategy and operations.

M&E data will be available online for use by all program members to promote learning and ensure transparency in decision making.

In 2014 and 2015 as RTB pilots RBM, the M&E system will be progressively restructured according to flagship design.

3. STAKEHOLDER PARTICIPATION

Stakeholder participation is critical to the RBM framework. IDOs cannot be achieved without the active engagement of a broad array of stakeholders. Stakeholders will need to buy into the overall theory of change and understand their accountability within the framework. This section explains the role of three different categories of stakeholders: partnerships, other CGIAR Research Programs, and regional organizations.

3.1 Partnerships

RTB is actively pursuing the involvement of global partners, who provide matching resources, in governance and management. CIRAD, representing a broader group of French partners, joined the CGIAR Centers with a seat in RTB's Steering Committee in May 2013; other candidates for inclusion are being considered. Strong collaboration is underway and CIRAD and Institut de recherche pour le développement (IRD) scientists have already been involved in the elaboration of flagships and the planning and implementation of RTB funded work on genetic resources, genomics, pathology, crop modeling, and value chains.

CGIAR Centers had an existing heritage of strong partnerships with advanced research institutes, particularly where they provide complementary resources and skills. These partnerships are being reconfigured in the context of RTB and new ones created. Some (but not all) of these are:

- Royal Holloway College: metabolomics profile platform for RTB crops
- Cornell University: genomics
- Natural Resources Institute: research on seed systems and postharvest
- Food and Environment Research Agency: risk assessment and surveillance
- Swedish University of Agricultural Sciences: seed degeneration
- Wageningen University: research on seed systems and seed degeneration
- Kansas State University: modeling seed degeneration, risk assessment

RTB collaborates with many national agricultural research organizations. To achieve IDOs, RTB is expanding collaboration with development partners. These include international NGOs such as Catholic Relief Services (CRS), a dynamic downstream partner able to support achievement of IDOs with complementary skills in seed system development and value chain integration, as well as with the private sector and national NGOs. RTB supports and strengthens existing partnership platforms and the events they convene—including the Global Cassava Partnership for the 21st Century (GCP 21), and the International Society for Tropical Root Crops (ISTRC).

3.2 CGIAR Research Programs

Other CRPS are important partners for RTB. They help to mitigate the risk of fragmentation, duplication of work, and to create synergies in terms of approaches, regional orientation, and resource use.

A4NH: A functional division of roles in research has been agreed. RTB has primary responsibility for breeding and value chain work for micronutrient-dense varieties, and A4NH leads high-throughput diagnostics for vitamin levels, nutritional efficacy, bioavailability studies, nutrition evidence, and public delivery related to improving nutrition and health in target populations (Annex 2).

Humidtropics: RTB is building linkage mechanisms with Humidtropics to develop shared impact pathways and joint accountability for outcomes. RTB does not have its own Action Sites and instead will build on those of systems CGIAR Research Programs where there is overlap with RTB hotspots. RTB is participating in the Action Area/Action Sites-workshops for joint coordination and planning. Options envisaged for collaboration are (1) joint baseline data collection, (2) shared innovation platforms, and (3) joint research program on cropping systems.

Climate Change, Agriculture and Food Security (CCAFS): RTB and CCAFS organized a joint workshop on risk assessment and modeling, creating a collaborative basis to predict how climate change will affect crop loss, and to provide advice to relevant stakeholders.

PIM: RTB and PIM have shared outcomes for value chain risk management and postharvest research. RTB focuses on improving postharvest technology, value chain integration, and PIM on enhancing value chain approaches and tools with a shared interest to leverage improved gender equity. PIM and RTB have also shared approaches and tools for priority setting, to strengthen the selection of technologies and parameterization of models used in both CRPs.

Livestock and Fish: Joint research on RTB crops as sources of feed has been analyzed in Uganda.

Genebank: RTB is collaborating and exploring options to improve utilization of accessions.

3.3 Regional and sub-regional organizations

RTB conducted a priority assessment with an online consultation with more than 1,600 stakeholders, including many partner organizations (see Annex 5 and http://www.rtb.cgiar.org/first-steps-completed-for-the-priority-assessment-for-roots-tubers-and-bananas/). RTB reached out to ASARECA (Association for Strengthening Agricultural Research in Eastern and Central Africa), CORAF (West and Central African Council for Agricultural Research and Development), and CCARDESA (Centre for Coordination of Agricultural Research and Development for Southern Africa) in Africa and IICA (Inter-American Institute for Cooperation on Agriculture, Costa Rica) in Latin America and the Caribbean to involve them in this and other activities. RTB has linked with the CGIAR-CAADP (Comprehensive Africa Agriculture Development Program) alignment process.

RTB will work with the regional and sub-regional organizations to improve engagement of critical R&D partners based on a number of criteria: their contribution to achieving flagships and realizing outcomes, their commitment and accountability, geographic location (in relation to RTB targets), and potential for going to scale.

4. PHASED WORK PLAN COVERING THE NINE YEAR PERIOD: 2016–2024

As flagships move from one stage to the next, and as new delivery flagships emerge out of the discovery flagships, the balance of research and outcome support and the roles of partners will change following the logic described in Table 2. This evolution is the primary driver of the phasing of the work plan, with direct budget implications described in the next section. As the flagship descriptions are still being finalized and the impact pathways need to be validated with local partners, at this moment only the overall tendencies can be described. The idea of this evolution is shown in Table 5, although the stages

still require further analysis. It illustrates that by the end of the nine-year period, a majority of delivery flagships will most likely be in stage 3, a few in stage 4, and others, especially those recently graduated from discovery, will still be in stage 1. So whilst the program portfolio begins to generate significant outcomes from 2016, most outcomes from the current delivery flagships will occur in the third period (2022–2024).

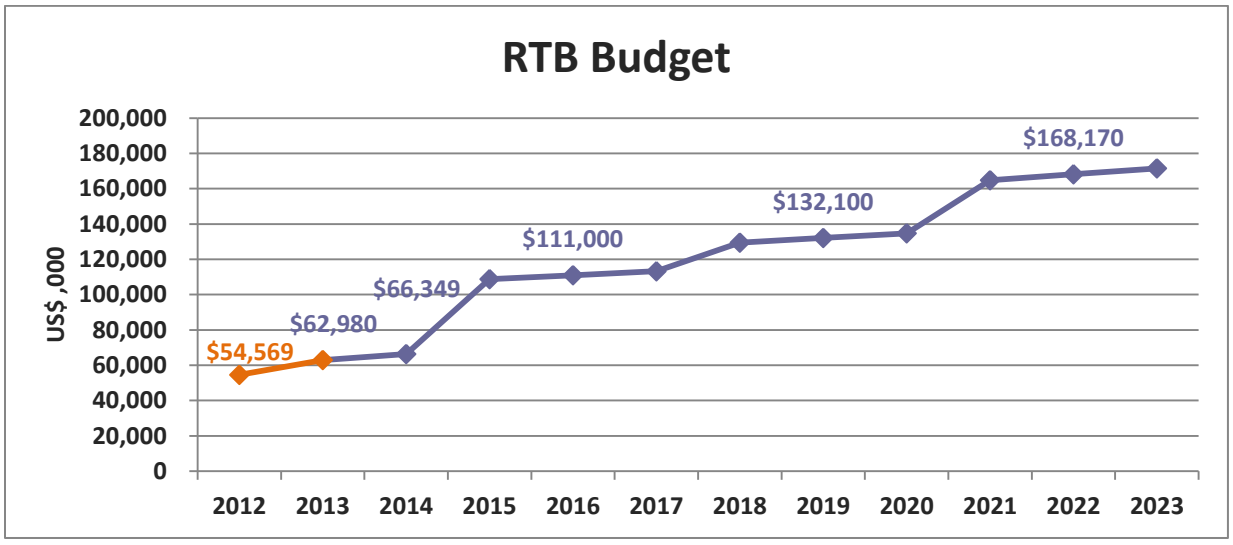
Table 5. Status of selected delivery flagships by stage

Flagship	2016–2018	2019–2021	2022–2024
Recovery, containment, and quarantine strategies of BBTD	Stage 2	Stage 2	Stage 3
Improved technology for cassava processing	Stage 2	Stage 3	Stage 3
3G approach to accelerated potato seed multiplication	Stage 2	Stage 2	Stage 3
Precocious early maturing potato	Stage 1	Stage 2	Stage 2
Resilient, nutritious OFSP varieties	Stage 3	Stage 3	Stage 4
Affordable and pest- and disease-free yam planting material	Stage 2	Stage 2	Stage 3
New flagship graduated from discovery	Discovery	Stage 1	Stage 1
New flagship graduated from discovery	Discovery	Discovery	Stage 1

5. BUDGET

The budget scenario for RTB over the nine-year timeframe is driven by flagship planning following the different types and stages of flagships (Figure 6). Delivery flagships will have a progressively larger budget as they move through stages with an increased share to outcome support and a larger proportion going to development partners.

Figure 6. Budget scenario by flagship for all windows ($US ,000)



The budget covers all funding windows and illustrates the need for joint planning with donors to plan investment. The research agenda and flagship/product portfolio can bring together, integrate, and add value to funding from all windows.

For further information and assumptions of budget calculation, see Annex 3.

ANNEXES

Annex 1. Preliminary identification of RTB flagships

Flagship product	Linked products	Centers/Partners (selection)	Geographic area(s)
DELIVERY FLAGSHIPS			
Banana			
Recovery, containment, and quarantine strategies for smallholder banana production with Banana bunchy top disease (BBTD)	• Strategies and information to increase awareness about the threat of BBTD at the international, national and local levels • Capacity building to more effectively implement quarantine, containment and recovery programs among national and local partners • Socio-economic tool box for addressing the needs and opportunities for women and other vulnerable and marginal groups to better target BBTD-focused initiatives • Learning, adaption and policy framework to build more effective innovation networks and impact pathways to address BBTD threats • Appropriate cropping system practices and marketing links with gender perspective to increase return on BBTV-free planting material	Bioversity, IITA, NARS, government agencies, NGOs, private sector	Africa, South and Southeast Asia as Risk avoidance in LAC
Gender specific integrated management of banana bacterial wilt (BXW)	• Diagnostic tools for detection and guidelines for surveillance • Early warning system for detection and rapid mobilization of action • Recommendation for the production and distribution of clean planting materials • Cultural control packages for within-field eradication and to limit further disease spread • Genetically modified resistant and infection- escaping varieties • Capacity strengthening in quarantine and prevention	Bioversity, IITA, NARS, government agencies, NGOs, private sector	East & Central SSA, South and Southeast Asia and LAC as per type of wilt
Global-to-local seeds system for Musa genetic diversity	• Quality planting material characterized, evaluated and distributed through Musa International Transit Center (ITC) • Clean plant material of desired varieties multiplied and delivered	Bioversity, IITA, NARS, government agencies, NGOs,	Global

Flagship product	Linked products	Centers/Partners (selection)	Geographic area(s)
	• Guidelines and tools for identifying gender-differentiated value adding and management options in self-regulated local seed systems, enriched with quality planting material from ITC • Characterization and evaluation tools, involving proteonomics, metabolomics and transcriptomics, to rationalize local seed systems	private sector	
Pre-emptive, emergency and ongoing response capacity to **fungal diseases** affecting smallholder banana and plantain systems	• Tools and guidelines for disease detection and surveillance, healthy soils, biological control, quarantine and prevention • Clean planting material • Resistant cultivars • Associated crops • Advocacy & capacity strengthening • Gender-specific management practices • Rational-effective integration of chemical control in an IPM approach	Bioversity, IITA, NARS, government agencies, NGOs, private sector	Southeast Asia as point of departure; other banana growing regions in Africa, LAC and elsewhere in Asia
Improved **banana varieties**	• Breeding strategy of global relevance, taking into account gender-differentiated consumer preferences • Phenotyped and genotyped varieties • Molecular markers for different traits (resistance to Sigatoka, weevils, nematodes and Fusarium; parthenocarpy • Hybrids released at national level and conserved at the Musa International Transit Center (ITC) • Guidelines for seed handling and fruit palatability	IITA,BIOVERSITY, NARO, FHIA, Taiwan Banana Research Institute, Queensland University of Technology	global, with differentiation according to regionally preferred traits
Cassava			
Small to medium scale cassava processing centers targeted preferentially toward rural women	• Life cycle assessment/waste management • Protocols for high product quality • Varieties with appropriate processing traits • New products, incl. research on access to gender responsive credit • Production and seed systems to meet processor demand • Training in best practices; knowledge dissemination		SSA, Asia, LAC (Andean zone, North-East Brazil), Caribbean

Flagship product	Linked products	Centers/Partners (selection)	Geographic area(s)
	• Value chain integration/new products, innovation platforms, and research on access to gender responsive credit		
Varieties with added value in new and high growth industrial markets for cassava	• Production practices for sustainable intensification and reduced cost • Seed systems • Processing systems • Linkage to markets		Mekong Delta; China; S. Brazil; Colombia; Paraguay; Nigeria
Varieties for improved profitability and sustainability in traditional food markets	• Production practices for sustainable intensification and reduced cost • Seed systems • Processing systems • Linkage to markets		SSA; Indonesia; Colombia; NE Brazil; Caribbean Basin
Farmer and consumer-accepted high Vitamin A cassava	• Production practices for sustainable intensification and reduced cost • Seed systems • Processing systems • Linkage to markets		SSA; Haiti; Colombia
Pre-emptive, emergency and ongoing response capacity to manage emergent biological constraints in Asia and the Americas (Cassava mealybug, whiteflies, frogskin, and witches broom)	• Farmer- and consumer-accepted varieties • Production practices for sustainable intensification and reduced cost • Seed systems • Processing systems • Linkage to markets		Mekong Delta; NE S. America; Caribbean Basin
Emergency and ongoing response capacity to manage persistent	• Farmer- and consumer-accepted varieties • Production practices for sustainable intensification and reduced cost • Seed systems		Africa

Flagship product	Linked products	Centers/Partners (selection)	Geographic area(s)
biological constraints in Africa (CMD, CBSD, whiteflies)	• Processing systems • Linkage to markets		
Potato			
"3G" (three generations) approach to accelerate seed multiplication and delivery	• Capacity development in rapid multiplication technology and business model • On-farm seed quality maintenance and ICM tools • Locally adapted tools & Protocols for seed quality control • Seed market intelligence and demand creation • Robust market demanded varieties • Knowledge and technology platform	CIP NARIs	SSA
70 & 100 day potato	• Opportunities for potato in value chains • Framework for advocacy for flexible variety release • Best practices for soil, water and pest management • Strategies to mitigate risks for reintensification (socio-economic & bio-physical) • Tools and capacities for client oriented breeding programs • Effcient seed delivery systems	CIP, Technituber Ltd. (India), BRAC & PROSHIKA (Bangladesh), Institute in Yunnan, Gansu, Qinghai (China), Cooperatives (Kyrgyzstan), FAO (Azerbaijan)	Southern and Central Asia
Sweetpotato			
Candidate resilient, nutritious orange-fleshed sweetpotato varieties	• Guidelines for selection and implementation of gender-responsive vine multiplication options • Demand creation and behavior change strategy • Value chains and delivery framework • Advocacy strategy to promote OFSP and food based approaches	CIP, SUN, CAADP, Save the Children, CARE, Worldvision, HKI, PATH, Unilever, CCCAP	Asia, SSA, the Caribbean

Flagship product	Linked products	Centers/Partners (selection)	Geographic area(s)
Yam			
Affordable and Pest and Disease-free Yam Planting Material	• Improved farmer preferred, market demanded yam varieties • Sustainable production and protection practices • Business plans for profitable seed yam and ware yam production and marketing systems • Effective clean seed yam production technologies • Novel high-ratio propagation techniques	IITA, CIRAD, NARS, NGOs	West Africa
Production models and planting material alternatives suited to different market, production and livelihood systems, resulting from yield gap, market and gender analyses	• Decision and monitoring tools for growers to guide labor- and resource efficient intensification process, with reduced fallow cycles and sustained productivity • Technology choices for particular constraints and gender- differentiated needs (clean planting material, cultivar choice, pest and disease management) • Guidelines for healthy soils based on crop associations, rotations and amendments • Productive varieties, including clonal selection of superior lines	Bioversity, CIAT, CIP, IITA,NARS, NGOs	Africa, South and Southeast Asia as points of departure; other banana growing regions in LAC and elsewhere in Africa & Asia
DISCOVERY FLAGSHIPS			
Improved RTB Varieties realizing accelerated genetic gains	• Integrated RTB breeding data management systems • Genetic Diversity access , assessment and incorporation into value added germplasm pools • RTB transformational platform of breeding technologies utilizing genomics, metabolomics and phenomics • Accelerated and decentralized participatory breeding and selection methods • Linkage to high ratio multiplication clean seed systems • Gender responsive baseline assessment of famer needs.	Bioversity, CIAT, CIP and IITA, The Royal Holloway University of London, Cornell University, Yale University	SSA[2] (West and East), Asia, LAC

[2] SSA: Sub-Saharan Africa, LAC: Latin America

Flagship product	Linked products	Centers/Partners (selection)	Geographic area(s)
Global Network of RTB in-situ conservation monitoring	• Monitoring system: methods, tools and databases (benchmark sites, catalogues, protocols, red lists) • Best practices: tested in-situ conservation strategies, methods & tools • Backup repository for threatened diversity: repatriation, restoration, incorporation • Ecosystem services model for RTB staples • Functional policies and incentive systems • Memory banks for collective knowledge systems		Asia/Oceania, LAC, SSA
Game changing traits/solutions (GMO)	• Waxy cassava starch • Herbicide Resistant cassava • Developing diagnostics tools for RTB bacterial diseases from genomic information • Identification of TAL effectors in Xam and their virulence targets in cassava; TALEN construction for genome editing of cassava • Disease free potato • Pest free sweetpotato • Tropical potato • New potato seed	Bioversity, CIAT, CIP and IITA, IRD	Need to map out target geographies by trait
~~CROSS-CUTTING~~LEARNING & SUPPORT **FLAGSHIPS**			
Global RTB Development Store	• Community of practice of RTB staff and partners on development brokering • Packaged, gender differentiated RTB products • Customer outreach and delivery system • Capacity development of next users for product uptake • Capacity strengthening for RTB staff / research partners on impact culture • Support service for virtual consultation and crowd sourced diagnosis • Policy analysis and advocacy • M&E system for higher efficiency and impact	Bioversity, CIAT, CIP, IITA, NARS, government agencies, NGOs, private sector	Global

Flagship product	Linked products	Centers/Partners (selection)	Geographic area(s)
Framework for analyzing and intervening in RTB seed systems	• Community of practice on RTB seed systems • Diagnosis of key bottlenecks constraining RTB seed systems • Capacity building modules for framework use • Principles and practices for gender mainstreaming in seed interventions • Guidelines on best practices for RTB seed system interventions	CIP, Bioversity, IITA, CIAT, WUR, SLU, KSU; several NARS	Global
Predictive models, diagnostic tools and IPM solutions for climate change-induced pest and disease risks and outbreaks	• Pest risk analysis,, surveillance strategies and diagnostic tools for target pests and pathogens developed • Analysis of risks through pathogen evolution • Pest and disease models and risk maps extended and improved • Impacts of CC on regional pest and disease distribution, crop losses and livelihoods analyzed • Generic pest and disease modeling platform for the analysis of CC impacts on resulting crop yields	Bioversity, CIP, CIAT, IITA, NARS, icipe, KSU, UoL, CIMMYT, IRRI, ICRISAT, FAO	Global with regional assessments in Africa (Kivu region), Asia and LAC
Demand-oriented solutions for value adding through improved post-harvest and risk management	• Use of waste and animal feed • Value chain risk and loss management toolbox • Market analyses for identification of opportunities for value adding through post-harvest treatment, processing, and product differentiation	Bioversity, CIAT, CIP, IITA, NRI, CIRAD, CRS	Global

Annex 2. Functional divisions of research and outcome support roles of A4NH and RTB

	A4NH	RTB
Breeding /germplasm development	Leads high-throughput diagnostics for vitamin levels (NIRS) platform and other minerals for most biofortified crops.	• Leads overall breeding program. • Supports and uses high through put diagnostics for vitamin levels and other quality traits.
Nutritional efficacy and bioavailability studies	Primary responsibility	No role
Delivery and Evidence / Advocacy	Leads on the nutrition evidence and public delivery related to improving nutrition and health in target populations.	Leads on key agriculture value chain delivery.
Value chain coordination, food processing, food industry	• Joint work, focus on looking at incentives and arrangements as they relate to consumption and improving nutritional quality (including gender), standards for biofortified products, and food safety. • Joint work on processing and foods.	• Joint work, taking the lead among key value chain actors related to agri-business, with a particular focus on gender relations as RTB commercialization increases. • Joint work on processing and foods.
Assessing nutrition and health outcomes	Primary responsibility	Supporting role through shared impact pathway

Annex 3. Additional information and assumptions for budget scenario

RTB Budget
(All Funds)

Period	Year	W1-2	W3	Bi-lateral	Discovery	Cross cutting	Delivery				Program Management	Total	Average per Period
							Stage 1	Stage 2	Stage 3	Stage 4			
Current	2012	22,307	3,811	28,451								54,569	61,300
	2013	29,210	6,754	27,017								62,980	
	2014	32,241	6,821	27,287								66,349	
Phase 2	2015				17,640	3,920	11,760	58,800	13,720	0	2,940	108,780	111,000
	2016				18,000	4,000	12,000	60,000	14,000	0	3,000	111,000	
	2017				18,360	4,080	12,240	61,200	14,280	0	3,060	113,220	
Phase 3	2018				18,522	4,116	12,348	51,450	28,812	10,290	3,920	129,458	132,100
	2019				18,900	4,200	12,600	52,500	29,400	10,500	4,000	132,100	
	2020				19,278	4,284	12,852	53,550	29,988	10,710	4,080	134,742	
Phase 4	2021				19,448	4,322	9,724	37,816	45,379	43,218	4,900	164,807	168,170
	2022				19,845	4,410	9,923	38,588	46,305	44,100	5,000	168,170	
	2023				20,242	4,498	10,121	39,359	47,231	44,982	5,100	171,533	

Number of flagships used for budget scenario

Flagship type (by stage)	2015-2017	2018-2020	2021-2023
Discovery	**3**	**3**	**3**
Cross cutting	4	4	4
Delivery: Stage 1	4	4	3
Delivery: Stage 2	12	10	7
Delivery: Stage 3	2	4	6
Delivery: Stage 4	0	1	4
TOTAL	**25**	**26**	**27**

Assumptions: Costs ($US)

2015-2017	2018-2020	2021-2023
6.000.000	6.000.000	6.000.000
1.000.000	1.000.000	1.000.000
3.000.000	3.000.000	3.000.000
5.000.000	5.000.000	5.000.000
7.000.000	7.000.000	7.000.000
10.000.000	10.000.000	10.000.000

Annex 4. Ex-ante estimates of adoption and number of beneficiaries from priority assessment

Flagship Product	Description	Target Countries	Maximum adoption (% of potential area and hectares)	Expected adoption 2023 (has)	Estimated number of beneficiaries ('000s)
Recovery, containment and quarantine strategies for smallholder banana production with Banana Bunchy Top Disease (BBTD)	Alternative approaches for rural communities to recover banana production whatever the BBTD pressure is, including strategies to create a banana-free zone to isolate disease-affected areas and supply of BBTV-free planting material; strategies and policies for surveillance and quarantine to limit the spread of BBTD within country and between countries; cutting edge technologies such as transgenic resistance, biological control of banana aphids and lower cost/field friendly diagnostic tools; incorporation of improved cropping systems practices into BBTD recovery strategies.	Africa: Angola, Benin, Burundi, Cameroon, Central African Republic, DR Congo, Congo, Equatorial Guinea, Gabon, Malawi, Nigeria, Rwanda, Zambia South(east) Asia: Indonesia, Philippines, Sri Lanka, Vietnam		130,000 (5.1% of total crop area in targeted countries)	Total of 6,833 (comprising 1,293 for yield recovery; and 5,540 for yield loss prevention)
Processing innovations and efficiencies for cassava	Improved technology and knowledge for small to medium scale cassava processing centers: farmer and consumer accepted varieties, production practices for sustainable intensification and reduced production cost and improved seed systems, linkage to markets.	South Sahara Africa: Nigeria, Cameroon, Ghana, Cote d'Ivoire, Uganda, Tanzania Asia: Thailand, Vietnam, Indonesia Latin America & Caribbean: Brazil, Colombia, Paraguay, Peru	SSA: 5% in 10 years Asia: 10% of industrial area in 10 years LAC&Carib: 10% of industrial area in 10 years	SSA: 150,000 Asia: 118,000 LAC: 67,000	SSA: 1,275 Asia: 1,300 LAC&Carib: 465,000
Candidate resilient, nutritious, orange-fleshed sweetpotato	Bio-fortification of sweet potato varieties to combat Vitamin A deficiency in resource-poor households with under-5 year old children to improve their diet quality	SSA: Nigeria, Ghana, Burkina Faso, Benin, Rwanda, Zambia, Burundi, Benin, Madagascar, Uganda, Tanzania, Malawi,	In 15 years, OFPS are one of the SP varieties over 2,500,000 has planted to sweet	In 10 years, OFSP is one of SP varieties over	SSA: 10,000 Rest: 5,000

Flagship Product	Description	Target Countries	Maximum adoption (% of potential area and hectares)	Expected adoption 2023 (has)	Estimated number of beneficiaries ('000s)
(OFSP) varieties	and increase their crop income	Mozambique, Kenya, Ethiopia, Angola, South Africa Asia: Bangladesh, India, Papua New Guinea and Indonesia The Caribbean: Haiti	potato crop by farmers	1,000,000 has planted to SPpotato by farmers	
Affordable and pest- and disease-free yam planting material	Production and diffusion of cleaned yam planting material and development and dissemination of elite high yielding yam clones in West and Central Africa	Nigeria, Cote d'Ivoire, Ghana, Benin, Togo, Central African Republic, Cameroon, Gabon, Chad, Burkina Faso and Mali	In 15 years: 30% in Ghana and Nigeria; 15% in rest (1,157,100 has)	In 10 years (60%): 694,000 has	10,650, 80% of which in Nigeria
Intensification of the cereal based systems through the introduction of shorter cycle potato varieties (the precocious potato)	Intensification of the cereal based systems by developing shorter cycle, heat tolerant and virus-free potato varieties for the subtropical rice-based systems in South Asia (70-day potatoes); and shorter cycle, heat and drought tolerant potato varieties for the temperate wheat-based systems in lowlands and highlands of Central Asia (90-110 days potatoes). These systems represent more than 40 million hectares.	South Asia: Bangladesh, the West Bengal state of India, the plains of Nepal, South West China, North Vietnam and Laos; Central Asia: North and West India, Pakistan, Tajikistan, Kyrgyzstan, and Uzbekistan	1.2% in 15 years (500,000 has)	300,000	2,150
Control of major Cassava pest and diseases in Africa (includes CMD, CSBD, Whitefly)	Development of high yielding CMD resistant varieties, whitefly control and related practices to address the major production constraint for poor farmers in all of sub-Saharan Africa increasing yields by 40%.	West Africa: Nigeria, Ghana, Cote d'Ivoire, Sierra Leone Central and East Africa: Uganda, Tanzania, Congo D.R., Angola, Cameroon Southern Africa: Malawi, Mozambique	40% in 15 years (2,015,000 has)	1,000,000	9,200

Flagship Product	Description	Target Countries	Maximum adoption (% of potential area and hectares)	Expected adoption 2023 (has)	Estimated number of beneficiaries ('000s)
Gender specific integrated management of banana bacterial wilt (BXW)	Build an effective research in development alliance with international and national partners for halting disease spread and reducing yield losses through quarantine, surveillance and the use of an integrated disease control package (comprising cultural practices, diagnosis and surveillance and resistant cultivars).	Africa: Burundi, DR Congo, Ethiopia, Kenya, Rwanda, Tanzania, Uganda		481,200 (14.2% of total crop area in targeted countries)	Total of 9,717 (comprising 4,169 for yield recovery; and 5,549 for yield loss prevention)

Annex 5. Expert survey responses: regional disaggregation by crop.

	SSA	LAC	ESEAP	SWCA	Global & others	Total per crop
Cassava	154	33	19	18	97	**321**
Potatoes	76	134	107	12	41	**370**
Sweet Potatoes	88	14	78	9	24	**213**
Bananas & Plantains	182	169	116	-	37	**504**
Yams	141	6	2	1	41	**191**
Total per region	**641**	**356**	**322**	**39**	**240**	***1,599***

A broad alliance of research-for-development stakeholders & partners